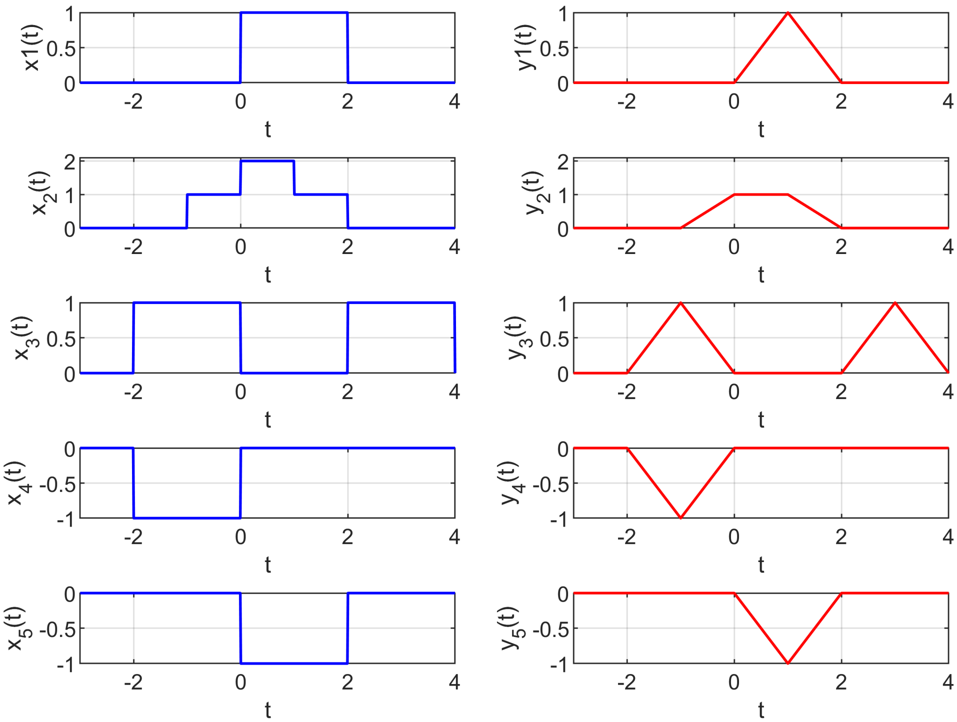
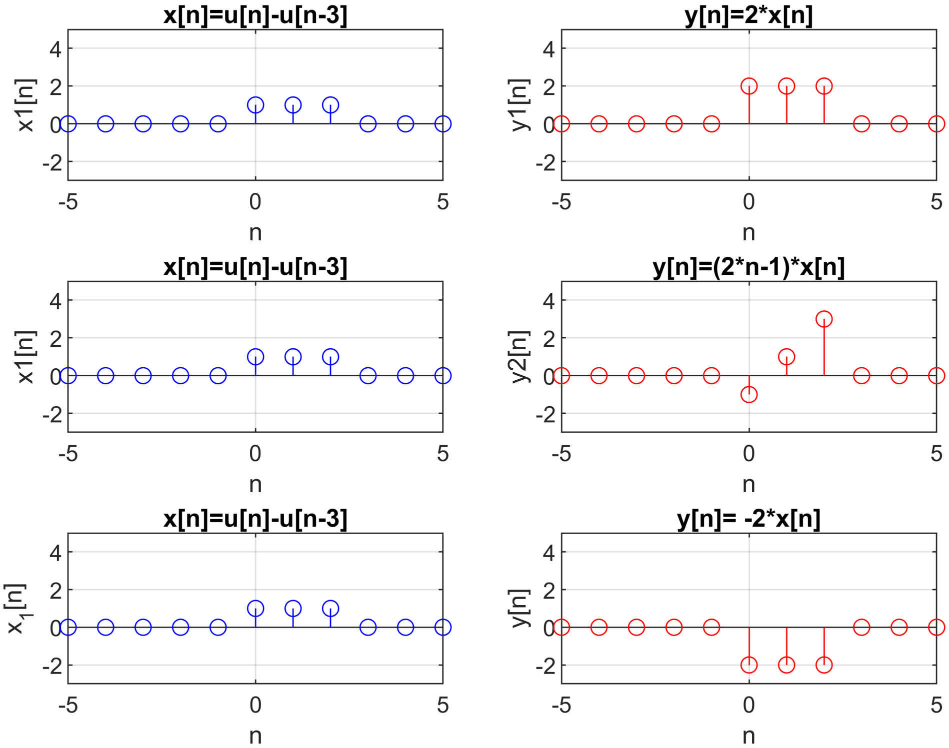
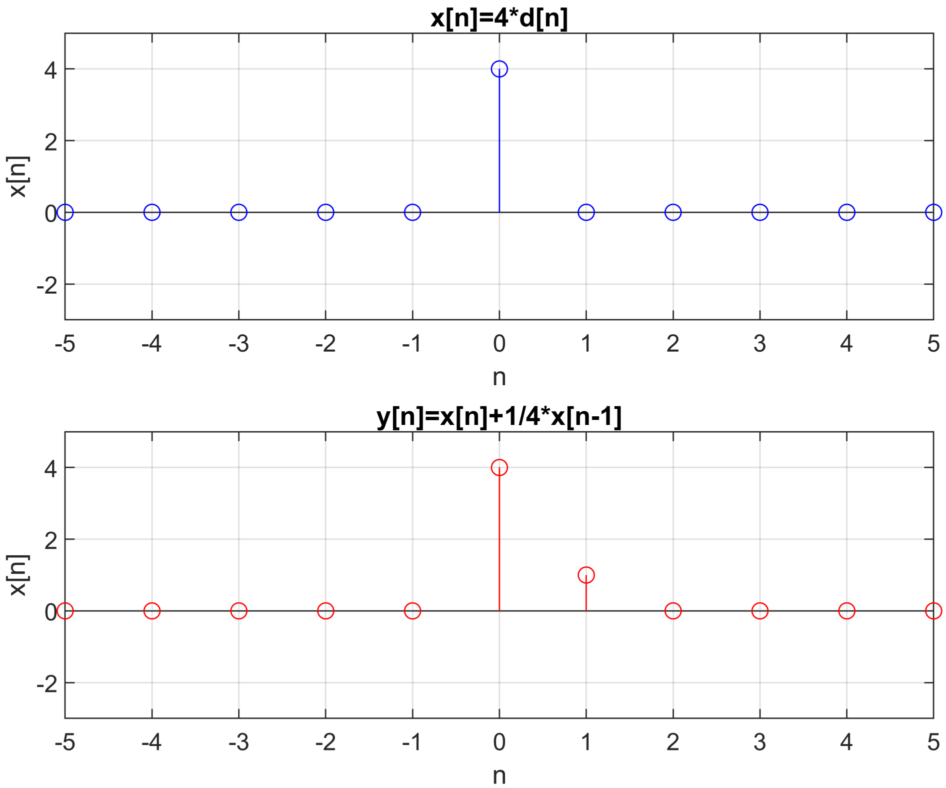
```
%Ex1
clear variables

figure
u=@(t)(t>=0);
x1=@(u,t)(u(t)-u(t-2));t=-3:0.01:4; subplot 521; plot(t,x1(u,t),'b','LineWidth',1);axis([-3 4 0
y1=@(u,t)(t.*(u(t)-u(t-1))+(u(t-1)-u(t-2)).*(2-t));subplot 522; plot(t,y1(u,t),'r','LineWidth',
x2=x1(u,t+1)+x1(u,t); subplot 523; plot(t,x2,'b','LineWidth',1); axis([-3 4 0 2.1]); grid; xlab
y2=y1(u,t+1)+y1(u,t); subplot 524; plot(t,y2,'r','LineWidth',1); axis([-3 4 0 2.1]); grid; xlab
x3=x1(u,t-2)+x1(u,t+2);subplot 525; plot(t,x3,'b','LineWidth',1); axis([-3 4 0 1]); grid; xlabe
y3=y1(u,t-2)+y1(u,t+2); subplot 526; plot(t,y3,'r','LineWidth',1); axis([-3 4 0 1]); grid; xlab
x4=-x1(u,t+2); subplot 527; plot(t,x4,'b','LineWidth',1); axis([-3 4 -1 0]); grid; xlabel('t')
y4=-y1(u,t+2); subplot 528; plot(t,y4,'r','LineWidth',1); axis([-3 4 -1 0]); grid; xlabel('t')
x5=-x1(u,t); subplot 529; plot(t,x5,'b','LineWidth',1); axis([-3 4 -1 0]); grid; xlabel('t'); y
y5=-y1(u,t); subplot (5,2,10); plot(t,y5,'r','LineWidth',1); axis([-3 4 -1 0]); grid; xlabel('t
```




```
%Ex2 d)
figure
x=@(n)(u(n)-u(n-3));
n=-5:5;
subplot(3,2,1); stem(n,x(n),'b');axis([-5 5 -3 5]); grid; xlabel('n'); ylabel('x1[n]');title('x
y1=2*x(n); subplot(3,2,2); stem(n,y1,'r'); axis([-5 5 -3 5]); grid; xlabel('n'); ylabel('y1[n]
subplot(3,2,3); stem(n,x(n),'b'); axis([-5 5 -3 5]); grid; xlabel('n'); ylabel('x1[n]'); title(
y2=(2*n-1).*x(n);subplot(3,2,4);stem(n,y2,'r');axis([-5 5 -3 5]); grid;xlabel('n'); ylabel('y2[
subplot(3,2,5);stem(n,x(n),'b'); axis([-5 5 -3 5]); grid; xlabel('n'); ylabel('x_1[n]'); title(
y3=(-2+(-1).^n+(-1).^(n-1)).*x(n); subplot(3,2,6);stem(n,y3,'r'); axis([-5 5 -3 5]); grid; xlab
```




```
%Ex3 c)
figure
x=@(n)(4*(n==0));
y=@(n)(x(n)+(1/4)*x(n-1));
subplot(2,1,1); stem(n,x(n),'b'); axis([-5 5 -3 5]); grid; xlabel('n'); ylabel('x[n]'); title(
subplot(2,1,2); stem(n,y(n),'r'); axis([-5 5 -3 5]); grid; xlabel('n'); ylabel('x[n]'); title(
```


x[n]=4*d[n]
x[n]
n
4
2
0
-2
-5
-4
-3
-2
-1
0
1
2
3
4
5
y[n]=x[n]+1/4*x[n-1]
x[n]
n
4
2
0
-2
-5
-4
-3
-2
-1
0
1
2
3
4
5

Oprea Sergiu-Daniel Gr. 30322/2

Tema lab 4

Ex. 2

S-intrare $x[n]$, ieşire $y[n]$

$$y[n] = x[n]\left(g[n] + g[n-1]\right)$$

a) $g[n] = 1 \ \forall n$, show that S invariant in time

$$\Rightarrow y[n] = x[n](1+1) = 2x[n]$$

$$\begin{cases} y_{x\text{-shifted}}[n] = T[x_{sh}[n]] = T[x[n-n_0]] = 2x[n-n_0] \\ y_{x\text{-}sh}[n] = y[n-n_0] \ ? \qquad y[n-n_0] = 2\cdot x[n-n_0] \end{cases}$$

$$\Downarrow$$

$$y_{s\_sh} = y[n-n_0] \Rightarrow S\text{-invariant în timp (LTI)}$$

b) $g[n] = n \ \forall n$, show that S invariant in time

$$\Rightarrow y[n] = x[n](n+n-1) = x[n](2n-1)$$

$$y_{x\text{-}sh}[n] = T[x_{sh}[n]] = T(x[n-n_0]) = (2n-1)\cdot x[n-n_0]$$

$$\left.\begin{aligned} y_{x\text{-}sh}[n] &= x[n-n_0](2n-1) \\ y[n-n_0] &= x[n-n_0](2(n-n_0)-1) \end{aligned}\right\} \Rightarrow \text{not equal} \Rightarrow S \text{ is not LTI}$$

c) $g[n] = -1+(-1)^n \ \forall n$, S-invariant in time

$$\Rightarrow y[n] = x[n]\left(-1+(-1)^n+1+(-1)^{n-1}\right) = x[n]\left((-1)^{n-1}(-1+1)-2\right) = -2x[n]$$

$$y_{x\text{-}sh}[n] = T[x_{sh}[n]] = T[x[n-n_0]] = \left(-2+(-1)^n+(-1)^{n-1}\right)x[n-n_0]$$

$$y[n-n_0] = x[n-n_0]\left(-2+(-1)^{n-n_0}+(-1)^{n-n_0-1}\right)$$

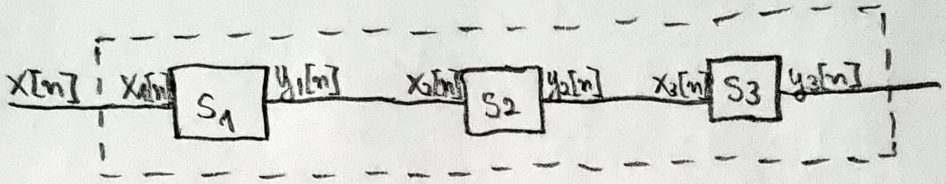
$$\Rightarrow x[n-n_0]\cdot(-2) = (-2)\cdot x[n-n_0] \Rightarrow S\text{-invariant in time (LTI)}$$

3. $S_1: \; y[n] = \begin{cases} x[\frac{n}{2}], & n\text{-par} \\ 0, & n\text{-impar} \end{cases}$

$S_2: \; y[n] = x[n] + \frac{1}{2}x[n-1] + \frac{1}{4}x[n-2]$

$S_3: \; y[n] = x[2n]$

a)



$y[n] = y_3[n]$

$x_3[n] = y_2[n]$

$x_2[n] = y_1[n]$

$x_1[n] = x[n]$

$y[n] = y_3[n] = x_3[2n] =$

$= x_2[2n] + \frac{1}{2}x_2[2n-1] + \frac{1}{4}x_2[2n-2] =$

$= \underbrace{y_1[2n]}_{x_1[\frac{2n}{2}] = x[n]} + \frac{1}{2}\underbrace{y_1[2n-1]}_{0} + \frac{1}{4}\underbrace{y_1[2n-2]}_{x_1[\frac{2(n-1)}{2}] = x[n-1]}$

$\Rightarrow y[n] = x[n] + \frac{1}{4}x[n-1]$

$y_{x\_sh}[n] = T[x_{sh}[n]] = T[x[n-n_0]] = x[n-n_0] + \frac{1}{4}x[n-n_0-1]$

$y[n-n_0] = x[n-n_0] + \frac{1}{4}x[n-n_0-1]$ $\Rightarrow$ equal

$\Rightarrow$ S - time invariant

$T[K \cdot x[n]] = K \cdot x[n] + \frac{1}{4} \cdot K \cdot x[n-1]$

$K \cdot T[x[n]] = K \cdot x[n] + \frac{1}{4} \cdot K \cdot x[n-1]$ $\Big\} \Rightarrow$ homogenous (1)

$T[x_1[n] + x_2[n]] = x_1[n] + x_2[n] + \frac{1}{4}x_1[n-1] + \frac{1}{4}x_2[n-1]$

$T[x_1[n]] + T[x_2[n]] = x_1[n] + \frac{1}{4}x_1[n-1] + x_2[n] + \frac{1}{4}x_2[n-1]$ $\Big\} \Rightarrow$ additive (2)

(1), (2) $\Rightarrow$ S - linear